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Claims

1. Membrane-electrode assembly for the electrolysis
5 of water, comprising
 - an ion-conducting membrane having a front side and a rear side (1)
 - a first catalyst layer on the front side (2)
 - a first gas diffusion layer on the front side
10 (4)
 - a second catalyst layer on the rear side (3)
 - a second gas diffusion layer on the rear side
15 (5)wherein the first gas diffusion layer (4) has smaller planar dimensions than the ion-conducting membrane (1) and the second gas diffusion layer (5) has essentially the same planar dimensions as the ion-conducting membrane (1).
- 20 2. Membrane-electrode assembly according to Claim 1, wherein the catalyst layer on the front side (2) and the catalyst layer on the rear side (3) of the ion-conducting membrane (1) have different planar dimensions.
- 25 3. Membrane-electrode assembly according to Claim 1 or 2, wherein the ion-conducting membrane (1) has a free surface (6) which is not supported by a gas diffusion layer on the front side.
- 30 4. Membrane-electrode assembly according to any of Claims 1 to 3, wherein the catalyst layers on the front side (2) and on the rear side (3) comprise catalysts comprising precious metals and
35 optionally ion-conducting materials.

5. Membrane-electrode assembly according to any of
Claims 1 to 4, wherein the margin of the gas
diffusion layers (4, 5) and the free surface (6)
of the ion-conducting membrane (1) which is not
5 supported by a gas diffusion layer are surrounded
by a sealing material (7).

6. Membrane-electrode assembly according to any of
Claims 1 to 5, wherein the gas diffusion layer on
10 the front side (4) comprises carbon-based
materials such as graphitized or carbonized carbon
fibre paper, carbon fibre nonwoven, woven carbon
fibre fabric and/or similar materials, while the
gas diffusion layer on the rear side (5) comprises
15 non-carbon based materials, for example woven
metal meshes, metal nonwovens, gauzes, metal
staple fibres, metal multifilaments and/or other
porous metallic structures.

20 7. Membrane-electrode assembly for the electrolysis
of water, comprising
- an ion-conducting membrane having a front side
and a rear side (1)
- a first catalyst layer on the front side (2)
25 - a first gas diffusion layer on the front side
(4)
- a second catalyst layer on the rear side (3)
wherein the ion-conducting membrane (1) has a free
surface (6) which is not supported by a gas
30 diffusion layer on the front side.

35 8. Membrane-electrode assembly according to Claim 7,
wherein the catalyst layer on the front side (2)
and the catalyst layer on the rear side (3) of the
ion-conducting membrane (1) have different planar

dimensions and comprise catalysts comprising precious metals and optionally ion-conducting materials.

- 5 9. Membrane-electrode assembly according to Claim 7 or 8, wherein the margin of the gas diffusion layer (4) and the free surface (6) which is not supported by a gas diffusion layer on the front side of the ion-conducting membrane (1) are
10 surrounded by a sealing material (7).
10. Membrane-electrode assembly according to any of Claims 1 to 9, wherein the ion-conducting membrane comprises organic polymers such as proton-conducting perfluorinated polymeric sulphonic acid compounds, doped polybenzimidazoles, polyether ketones, polysulphones or ion-conducting ceramic materials and has a thickness of from 10 to 200 µm.
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11. Membrane-electrode assembly according to any of Claims 1 to 10, wherein the second catalyst layer on the rear side (3) comprises catalysts containing precious metals for the anodic evolution of oxygen, preferably catalysts based on iridium and/or ruthenium.
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12. Membrane-electrode assembly according to any of Claims 1 to 11, wherein the sealing material (7) comprises thermoplastic polymers from the group consisting of polyethylene, polypropylene, polytetrafluoroethylene, PVDF, EPDM, polyester, polyamide, polyamide elastomers, polyimide, polyurethane, silicones, silicone elastomers, etc., and/or thermoset polymers from the group consisting of epoxides and cyanoacrylates.
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13. Process for producing the membrane-electrode assembly according to any of Claims 1 to 12, which comprises the steps:

- (a) coating of an ionomer membrane (1) with catalyst on one side,
- 5 (b) coating of a carbon-based gas diffusion layer (4) with catalyst on one side,
- (c) joining of the carbon-based, catalyst-coated gas diffusion layer (4) to the uncoated side of the ionomer membrane (1), with the catalyst layer (2) coming into contact with the ionomer membrane (1),
- 10 (d) optionally, application of a non-carbon based gas diffusion layer (5) to the rear side, with the catalyst layer (3) on the ionomer membrane (1) coming into contact with the gas diffusion layer (5),
- 15 (e) application of a sealing material (7) in the peripheral region of the membrane-electrode assembly.
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14. Process according to Claim 13, wherein the joining of the carbon-based, catalyst-coated gas diffusion layer (4) to the uncoated side of the ionomer membrane (1) is carried out at elevated temperature and/or elevated pressure.

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15. Process according to Claim 13 or 14, wherein the application of the sealing material (7) is effected by means of melting processes, injection moulding, heat pulse welding and/or hot pressing.

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16. Use of the membrane-electrode assembly according to Claim 1 in electrolyzers, regenerative fuel cells, oxygen-producing electrodes or other electrochemical devices.